Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

10 years on, the world still learns from SARS

With eerie coincidence, a new coronavirus has emerged on the tenth anniversary of the SARS outbreak. Carrie Arnold looks at how the 2003 outbreak shaped disease surveillance and response.

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For the **chronology of SARS** see http://www.who.int/csr/don/2003_07_04/en/

For **SARS in Guangdong** see *Lancet* 2003; **362:** 1353–58. http://dx.doi.org/10.1016/S0140-6736(03)14630-2/

For more on **the 2003 SARs outbreak** see *Science* 2013; **339:** 1287–88. DOI:10.1126/science.1236434

In early 2003, Hong Kong virologist Malik Peiris thought several of his patients with severe pneumonia at Queen Mary Hospital were yet more human cases of avian influenza. Patients did not respond to antibiotics, and the severity of the illness was consistent with H5N1 influenza, which was then circulating in the area. Rumours abounded that a similar severe pneumonia was being found in nearby Guangdong, on mainland China, which only raised suspicions of a major influenza outbreak. Public health officials were bracing themselves for what they were sure was the next big pandemic.

They got their pandemic, but it was not influenza. It was an entirely new disease that would ultimately be called SARS. The disease outbreak showed the infectious disease community just how unprepared it was for a major pandemic.

"SARS changed the spirit of things", said Isabelle Nuttall, director of WHO's the Global Capacities Alert and Response Unit. "It showed us that anything can happen anywhere."

As an infectious disease physician at a major Hong Kong hospital, Peiris was one of the people at the centre of the SARS epidemic. His team identified and isolated the coronavirus that causes SARS, and his clinical expertise helped to control the hospital-based spread of the virus. Through hard work and international efforts led by physicians like Peiris and public health agencies like WHO, the SARS outbreak was halted less than a year after it began.

James King-Holmes/Science Photo Library

Emerging infections can travel the world faster than ever before

> **"...the SARS outbreak and ongoing low-level transmission of H5N1 avian influenza provided the impetus for WHO to act..."**

"We learned that any infectious disease outbreak anywhere in the world today could be a problem for the whole world tomorrow", Peiris told *TLID*. "These lessons were reinforced by the influenza pandemic of 2009, although that turned out to be less severe."

Perhaps one of the largest stumbling blocks to bringing SARS under control was an initial lack of transparency from Chinese authorities. When the first reports of a new pneumonia striking Guangdong began to emerge, the government did not step in to notify physicians, public health agencies, or other governments in the area.

At the time, WHO rules only required the reporting of four diseases: yellow fever, cholera, plague, and smallpox. Since the early SARS cases were clearly none of these, no government was under any sort of official obligation to notify WHO about them. Nuttall noted that this was a huge loophole of the existing health regulations. By the time SARS got too big to ignore, it had already spread far beyond the borders of Guangdong, making the disease much harder to contain.

Also missing was the laboratory capacity needed to detect and identify such emerging pathogens. Peiris noted that some of the areas where SARS hit the hardest—Hong Kong, Singapore, Toronto—had adequate biosafety facilities to run the appropriate tests. Other areas, like Cambodia and Vietnam, simply did not have that capability. If SARS had emerged in more resource-poor areas, he said, it could have taken a lot longer to bring the outbreak under control.

As a result of these poignant lessons, WHO officials decided to formally update the International Health Regulations (IHRs), a legally binding agreement. Public health officials had realised, even before SARS, that the IHR mandatory reporting requirements of only four diseases were inadequate. Arguments and ideas were continually bounced around but never enacted. In 2003, the SARS outbreak and ongoing low-level transmission of H5N1 avian influenza provided the impetus for WHO to act, Nuttall explained.

The new IHRs that were voted on in 2005 and began to be legally enforced in 2007 encapsulate many of the lessons epidemiologists and infectious disease physicians have learned during SARS. The IHRs form a sort of map or template of what countries and local communities need to do to be on the lookout for infectious disease outbreaks, and how they should respond when one of these outbreaks is detected. To start, the new IHRs give broader powers to WHO to investigate infectious disease threats and communicate them to the world, even without the support of local or national government. They also broaden the types of sources that WHO can use to begin an outbreak investigation.

Previously, a request for WHO involvement had to go through official government channels. In the case of SARS, the Chinese authorities did

not request help or even notify WHO of the unusual cluster of pneumonia cases. WHO had heard about these cases through unofficial channels, but, because of stipulations in the older IHRs, they could not formally intervene, only watch and wait. Now, WHO can use these unofficial reports and even relevant newspaper articles as justification to intervene should it be warranted.

Improved laboratory capacity is also at the core of the new IHRs. The regulations require all countries to have infectious disease laboratories to test samples and do other routine surveillance tasks. "A lot of what we do to detect disease is really just boring old surveillance", said John Oxford, a virologist working at Retroscreen Virology.

As boring as surveillance may be, Oxford noted, it is the key to identifying disease outbreaks from any source. Nuttall, too, cites this as one of the cornerstones of the new IHR. Although countries have until the end of 2013 to come into compliance with these regulations, many countries have asked for additional time to assemble the necessary resources.

Another power newly given to WHO in the revised IHR is their ability to do risk assessments and communication. One of the major reasons governments hesitate to inform the international community about disease outbreaks in their borders is the potential effect on trade and tourism. SARS was tremendously disruptive to business in Canada, China, and other parts of southeast Asia. People postponed or cancelled travel to these areas to avoid contracting the virus. Although these fears are certainly understandable, researchers know now that much of SARS transmission was centred in hospitals and health-care facilities, not by casual contact in everyday settings.

"It can be a delicate balance between sharing information and sparking panic", said James Hughes (Emory University), former director of the National Center for Infectious Diseases at the CDC. "In today's world, it's not possible for countries to keep secrets for very long. It's an incentive that favors early reporting."

Although new diseases like SARS tend to have the splashiest headlines and garner the most media attention, most of the diseases that affect the largest numbers of people are the plagues we have known about for years, if not centuries. "By far, most of the outbreaks we see are from known pathogens", Nuttall said. Still, this does not mean that an as yet unseen virus cannot cause major problems. 30 years ago, HIV was still a strange, emerging virus.

Some of the best ways to combat these diseases, emerging or otherwise, are not splashy and sexy, either, notes Oxford. During SARS, airports deployed heat sensors to measure fever of passengers. Though fancy and expensive, they did little to stop the spread of the virus.

> "'It's a recurrent lesson in infectious disease—expect the unexpected'"

"The best thing to do during any disease outbreak is ensuring people wash their hands. Although we know this, most of us still aren't very good about it", Oxford said. The money spent on this expensive equipment would have been better spent, in Oxford's opinion, on sinks, soap, and running water, along with better personal protective equipment for health-care workers.

The H1N1 influenza outbreak in 2009 was perhaps the first main test of the new IHR. Officials from WHO and the larger public health community said that the new guidelines were successful. The Mexican government reported the outbreak quickly, and teams around the world worked together to track and respond to the virus.

Lea Paterson/Science Photo Library

Sinks, soap, and running water remain the best way to halt transmission

"We also saw Mexicans being stigmatised, and then, with the term 'swine flu', the pork industry was stigmatised", Hughes said. The ongoing risk of stigma and blame is one of the many needs for effective risk communication. When the public understands what is really going on, they can better respond to the actual threats from the disease and respond appropriately.

Other emerging viruses, like the coronavirus causing severe pneumonia in the Middle East and UK, continue to help test and refine the usefulness of the IHRs. Despite its eerie emergence almost a decade after SARS, this new coronavirus is only distantly related to is more notorious relative, and its much less efficient at spreading from person to person. Thus far, researchers have seen no large clusters of cases that indicate it will be a larger threat, although that could change at any time.

"It's a recurrent lesson in infectious disease—expect the unexpected", Hughes said.

Even as this story went to press, officials in China are reporting cases of a rare H7N9 avian influenza that has so far made 24 people ill, killing seven. Each outbreak, Nuttall says, helps the infectious disease community learn and better respond to future outbreaks.

Carrie Arnold